IN THE SPECIFICATION

[0003] The efficiency of the heat pump system is commonly a function of the temperature of the liquid to be heated where the colder the liquid to be heated is, the more efficient the heat pump system becomes. This is because the temperature of the refrigerant exiting the heat rejecting heat exchanger in the heat pump is lower when the temperature of the liquid to be heated is lower, and this causes the enthalpy entering the heat absorbing heat exchanger to be lower, allowing the refrigerant to absorb more heat and to reject this heat into the liquid to be heated, increasing the efficiency of the heat pump process. This is especially true for transcritical vapor compression heat pump systems using carbon dioxide as the refrigerant.

[0004] When the heat pump system has satisfied its setpoint conditions, it is typically shut off until the control system determines it is appropriate to turn the system on again. While the system is off in low ambient temperature conditions, it is possible (given enough time) that the liquid outside the storage reservoir can freeze, impacting the performance and possibly damaging the equipment. Prior art methods for preventing this freezing are to circulate the liquid at low flow rate through the system outside the storage tank by using the same pump normally used to circulate the liquid while the system is on.